or Channel 13 with the augmentation signal from the proponent-furnished modulator, modulated with the multi-pattern. Measure the power level of this signal, using the method specified by the proponent, at the input to the proponent-furnished demodulator. Place the untested NTSC signal on Channel 23. With these modifications, repeat the procedure of Step 1. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to test both upper-half and lower-half utilization of the augmentation channel. (See Note in Section 19.3.3.1.1, above.)

(4) The following steps test interference between the proponent ATV signal and another identical ATV signal, and between the main and augmentation channels of an augmentation system. According to the type of system being tested, execute the appropriate step(s) below:

(a) To test an Enhanced-NTSC system, replace the desired NTSC signal on Channel 12 with the enhanced-NTSC signal, modulated with the special interference test picture with a gray area. That same enhanced-NTSC signal, delayed, serves as the undesired signal on Channel 11 or Channel 13. At each of the three carrier levels, for the desired signal, and on each of the two channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. Measure all RF power levels at the peak of sync. With these modifications, repeat the procedure of Step 1.

(b) To test a Simulcast system, replace the desired NTSC signal on Channel 12 with the simulcast signal, modulated with the special interference test picture with a gray area. That same simulcast signal, delayed, serves as the undesired signal on Channel 11 or Channel 13. At each of the three carrier levels, for the desired signal, and on each of the two channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. Measure all RF power levels using the method specified by the proponent. With these modifications, repeat the procedure of Step 1.

(c) To test the NTSC signal of an Augmented-NTSC system, as the desired signal, with respect to the augmentation signal of that system, as the undesired signal, replace the desired NTSC signal on Channel 12 with the NTSC signal from the proponent-furnished modulator, modulated with the special interference test picture with a gray area. Measure the RF power level of the NTSC signal at the peak of sync. The augmentation signal, delayed, serves as the undesired signal on Channel 11 or Channel 13. Measure the RF power level of the augmentation signal using the method specified by the the proponent. Place the undelayed augmentation signal on Channel 23. At each of the three carrier levels, for the desired signal, and on each of the two channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. With these modifications, repeat the procedure of Step 1. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to test both upper-half and lower-half utilization of the augmentation channel. (See Note in Section 19.3.3.1.1, above.)

(d) To test the augmentation signal of an Augmented-NTSC system, as the desired signal, with respect to the NTSC signal of that system, as the undesired signal, replace the desired NTSC signal on Channel 12 with the augmentation signal from the proponent-furnished modulator, modulated with the special interference test picture with a gray area. Measure the RF power level of the augmentation signal using the method specified by the proponent. The NTSC signal from the proponent-furnished modulator, delayed, serves as the undesired signal on Channel 11 or Channel 13. Measure the RF power level of the NTSC signal at the peak of sync. Place the undelayed NTSC signal on Channel 23. At each of the three carrier levels, for the desired signal, and on each of the two channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. With these modifications, repeat the procedure of Step 1. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to test both upper-half and lower-half utilization of the

augmentation channel. (See Note in Section 19.3.3.1.1, above.)

(e) To test the NTSC signal of an Augmented-NTSC system, as both the desired signal and the undesired signal, replace the desired NTSC signal on Channel 12 with the NTSC signal from the proponent-furnished modulator, modulated with the special interference test picture with a gray area. The NTSC signal, delayed, serves as the undesired signal on Channel 11 or Channel 13. Measure the RF power level of the NTSC signals at the peak of sync. Place the augmentation signal on Channel 23. At each of the three carrier levels, for the desired signal, and on each of the two channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. With these modifications, repeat the procedure of Step 1.

(f) To test the augmentation signal of an Augmented-NTSC system, as both the desired signal and the undesired signal, replace the desired NTSC signal on Channel 12 with the augmentation signal from the proponent-furnished modulator, modulated with the special interference test picture with a gray area. The augmentation signal, delayed, serves as the undesired signal on Channel 11 or Channel 13. Measure the RF power level of the augementation signals using the method specified by the proponent. Place the NTSC signal from the proponent-furnished modulator on Channel 23. At each of the three carrier levels, for the desired signal, and on each of the two channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. With these modifications, repeat the procedure of Step 1. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to test both upper-half and lower-half utilization of the augmentation channel. (See Note in Section 19.3.3.1.1, above.)

19.3.3.2.3 UHF Taboo Channel Interference

The UHF taboos originate from four interference mechanisms -- intermodulation, half-IF, IF beats, and IF image frequencies. For a given desired channel, there are twelve prohibited channel assignments resulting from these mechanisms. In order to reduce the total number of tests, and the required test time for each proponent system, ATTC will test only a subset of these prohibited channels.

The half-IF taboo is caused by the difference frequency between the second harmonic of the undesired signal and the second harmonic of the local oscillator falling within the IF band of the receiver. For an IF of approximately 44 MHz, the prohibited channel is n + 4. No identified ATV proponent has indicated that any other IF will be employed in the equipment to be provided to ATTC. Therefore, ATTC plans to test the half-IF taboo only on Channel n + 4. This plan is subject to change if another IF is employed.

An IF beat can result from either of two conditions. There can be a second-order beat, between the desired and undesired picture carriers, that falls within the IF band of the receiver. For a 44-MHz IF, the interfering carriers are on Channels n - 7 and n + 7.

For NTSC signals, the n ± 7 taboo is caused by a beat generated at 42 MHz between picture carriers that are seven channels apart. For NTSC signals, the n ± 8 taboo is caused by a beat generated at 43.5 MHz by a picture carrier and an aural carrier that are eight channels apart.

There are two sources of image interference; one related to the picture carrier, and the other related to the sound carrier. Image interference mechanisms, unlike those described above, are linear. In an NTSC receiver, the desired carrier frequency is below the frequency of the local oscillator by the intermediate frequency (IF). However, an undesired carrier at the so-called "image frequency", that is above the desired carrier by twice the IF, will produce a spurious signal within the IF band. For a 44-MHz IF, the sound image channel is Channel n + 14, and the picture image channel is Channel n + 15. Both of these channels will be tested.

For these tests, UHF Channel 23 is used for the desired channel. Each taboo is tested individually.

Four cases must be tested: (1) NTSC into NTSC, as a reference; (2) NTSC into ATV; (3) ATV into NTSC; and (4) ATV into ATV. Case 4 is subject to certain limitations, previously discussed.

For each undesired channel assignment shown in Table 19.5, execute Steps 1 through 4 that follow the table.

TABLE 19.5

	UHF TABOO	UNDESIRED CHANNEL
Non-Linear	n - 8 IF Beat	15
	n - 7 IF Beat	16
	n - 4 Intermodulation	19
	n - 2 Intermodulation	21
	n + 2 Intermodulation	25
	n + 4 Half IF	27
	n + 7 IF Beat	30
	n + 8 IF Beat	31
Linear	n + 14 Sound Image	37
	n + 15 Picture Image	38

Execute the following steps:

(1) NTSC, as the desired signal, is on Channel 23 with a 50-IRE flat-field signal, modulated according to FCC specifications. The peak-of-sync carrier level, measured at the input to the NTSC receivers, is set, in turn, at -55 dBm, -35 dBm, and -15 dBm. The undesired signal is on each channel of Table 19.5, in turn, modulated with color bars. The two sync generators are not locked. At each of the three carrier levels, for the desired signal, and on each of the taboo channels, for the undesired signal, adjust the RF level of the undesired signal to find the threshold of visibility of the interference, the level at which the digital BER increases to 10^{-4}, and the level at which the BER reaches 10^{-3}. Using the ascending/descending method, four of the five expert

observers must concur on the threshold of visibility. Record the RF level at the threshold of visibility, and measure the BER of the digital channel at this level. Also record the RF levels corresponding to BERs of 10^{-4} and 10^{-3}. A suggested format for this documentation is shown in Figure --.

(2) According to the type of system being tested, execute the appropriate step(s) below:

(a) To test an Enhanced-NTSC system, replace the desired NTSC signal on Channel 23 with the enhanced-NTSC signal, modulated with a flat field. Measure the power level of this signal, at the peak of sync, at the input to the proponent-furnished demodulator. With these modifications, repeat the procedure of Step 1.

(b) To test a Simulcast system, replace the desired NTSC signal on Channel 23 with the simulcast signal, modulated with a flat field. Measure the power level of this signal, using the method specified by the proponent, at the input to the proponent-furnished ATV demodulator. With these modifications, repeat the procedure of Step 1.

(c) To test the NTSC channel of an Augmented-NTSC system, replace the desired NTSC signal on Channel 23 with the NTSC signal from the proponent-furnished modulator, modulated with a flat field. Measure the power level of this signal, at the peak of sync, at the input to the proponent-furnished demodulator. Place the untested augmentation signal on Channel 12. With these modifications, repeat the procedure of Step 1.

(d) To test the augmentation channel of an Augmented-NTSC system, replace the desired NTSC signal on Channel 23 with the augmentation signal, modulated with a flat field. Measure the power level of this signal, using the method specified by the proponent, at the input to the proponent-furnished ATV demodulator. Place the untested NTSC signal on Channel 12. With these modifications, repeat the procedure of Step 1. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to test both

upper-half and lower-half utilization of the augmentation channel.

(3) Return the NTSC flat-field signal to Channel 23 as the desired signal. According to the type of system being tested, execute the appropriate step(s) below:

(a) To test an Enhanced-NTSC system, replace the undesired NTSC signal on each taboo channel, shown in Table 19.5, with the enhanced-NTSC signal, modulated with color bars. With this modification, repeat the procedure of Step 1 for each taboo channel.

(b) To test a Simulcast system, replace the undesired NTSC signal on the taboo channel with the simulcast signal, modulated with the multi-pattern. Measure the power level of this signal, using the method specified by the proponent, at the input to the proponent-furnished demodulator. With these modifications, repeat the procedure of Step 1 for each taboo channel.

(c) To test the NTSC signal of an augmented-NTSC system, replace the undesired NTSC signal on the taboo channel with the NTSC signal from the proponent-furnished modulator, modulated with color bars. Measure the power level of this signal, at the peak of sync, at the input to the proponent-furnished demodulator. Place the untested augmentation signal on Channel 12. With these modifications, repeat the procedure of Step 1 for each taboo channel.

(d) To test the augmentation channel of an augmented-NTSC system, replace the undesired NTSC signal on the taboo channel with the augmentation signal from the proponent-furnished modulator, modulated with the multi-pattern. Measure the power level of this signal, using the method specified by the proponent, at the input to the proponent-furnished demodulator. Place the untested NTSC signal on Channel 12. With these modifications, repeat the procedure of Step 1 for each taboo channel. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to

test both upper-half and lower-half utilization of the augmentation channel.

(4) The following steps test interference between the proponent ATV signal and another identical ATV signal, and between the main and augmentation channels of an augmentation system. According to the type of system being tested, execute the appropriate step(s) below:

(a) To test an Enhanced-NTSC system, replace the desired NTSC signal on Channel 23 with the enhanced-NTSC signal, modulated with the special interference test picture with a gray area. That same enhanced-NTSC signal, delayed, serves as the undesired signal on the taboo channel. At each of the three carrier levels, for the desired signal, and on each of the taboo channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. Measure all RF power levels at the peak of sync. With these modifications, repeat the procedure of Step 1 for each taboo channel.

(b) To test a Simulcast system, replace the desired NTSC signal on Channel 23 with the simulcast signal, modulated with the special interference test picture with a gray area. That same simulcast signal, delayed, serves as the undesired signal on the taboo channel. At each of the three carrier levels, for the desired signal, and on each of the taboo channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. Measure all RF power levels using the method specified by the proponent. With these modifications, repeat the procedure of Step 1 for each taboo channel.

(c) To test the NTSC signal of an Augmented-NTSC system, as the desired signal, with respect to the augmentation signal of that system, as the undesired signal, replace the desired NTSC signal on Channel 23 with the NTSC signal from the proponent-furnished modulator, modulated with the special interference test picture with a gray area. Measure the RF power level of the NTSC signal at the peak of sync. The augmentation signal, delayed, serves as the undesired signa

on the taboo channel. Measure the RF power level of the augmentation signal using the method specified by the the proponent. Place the undelayed augmentation signal on Channel 12. At each of the three carrier levels, for the desired signal, and on each of the taboo channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. With these modifications, repeat the procedure of Step 1 for each taboo channel. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to test both upper-half and lower-half utilization of the augmentation channel.

(d) To test the augmentation signal of an Augmented-NTSC system, as the desired signal, with respect to the NTSC signal of that system, as the undesired signal, replace the desired NTSC signal on Channel 23 with the augmentation signal from the proponent-furnished modulator, modulated with the special interference test picture with a gray area. Measure the RF power level of the augmentation signal using the method specified by the proponent. The NTSC signal from the proponent-furnished modulator, delayed, serves as the undesired signal on the taboo channel. Measure the RF power level of the NTSC signal at the peak of sync. Place the undelayed NTSC signal on Channel 12. At each of the three carrier levels, for the desired signal, and on each of the taboo channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. With these modifications, repeat the procedure of Step 1 for each taboo channel. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to test both upper-half and lower-half utilization of the augmentation channel.

(e) To test the NTSC signal of an Augmented-NTSC system, as both the desired signal and the undesired signal, replace the desired NTSC signal on Channel 23 with the NTSC signal from the proponent-furnished modulator, modulated with the special interference test picture with a gray area. The NTSC signal, delayed, serves as the undesired signal on the taboo channel. Measure the RF power level of the NTSC signals at the peak of sync. Place the augmentation signal

on Channel 12. At each of the three carrier levels, for the desired signal, and on each of the taboo channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. With these modifications, repeat the procedure of Step 1 for each taboo channel.

(f) To test the augmentation signal of an Augmented-NTSC system, as both the desired signal and the undesired signal, replace the desired NTSC signal on Channel 23 with the augmentation signal from the proponent-furnished modulator, modulated with the special interference test picture with a gray area. The augmentation signal, delayed, serves as the undesired signal on the taboo channel. Measure the RF power level of the augmentation signals using the method specified by the proponent. Place the NTSC signal from the proponent-furnished modulator on Channel 12. At each of the three carrier levels, for the desired signal, and on each of the taboo channels, for the undesired signal, vary the delay to find the worst-case visibility of the interference. With these modifications, repeat the procedure of Step 1 for each taboo channel. If the proponent system uses a 3-MHz augmentation signal, repeat the procedure to test both upper-half and lower-half utilization of the augmentation channel.

19.3.3.2.4 Discrete Frequency Interference

The setups for these tests are the same as those described in Section 19.3.3.1.1 for the ATV/NTSC tests, with the few exceptions that follow. Only the Calibration, NTSC-1, and NTSC-2 setups will be tested. (In the case of an ATV system that uses a half-bandwidth augmentation channel, both NTSC-2a and -2b variations are tested, and the range of interference frequencies tested is limited to that portion of the channel occupied by the augmentation signal. See the Note in Section 19.3.3.1.1, above.) The undesired NTSC signal, used in the ATV/NTSC tests, is replaced by a discrete frequency for these tests, using means described below. To enhance the visibility of the interference, the discrete-frequency serves as a carrier, amplitude modulated by a 400-Hz sine wave. The flat field test signal will be used as the desired video in all cases.

Two broadcast channels are used for these tests. The desired signal occupies one channel. A second channel is used for the augmentation signal, when the main channel is being tested as the desired channel, or for the main signal, when the augmentation channel is under test.

Select Channel 12 for the desired channel, by tuning the associated frequency synthesizer to approximately 251 MHz. Select Channel 23 for the second channel, by tuning the associated synthesizer to 571 MHz. Set the attenuator in the desired signal path for maximum attenuation, and adjust the amplitude of the desired signal to -35 dBm, as measured at the ATV receiver input.

Refer to Figure -- for a functional diagram of the setup for this test.

The modulated CW interference frequencies to be used are in approximate 0.25 MHz increments across Channel 12 (204-210 MHz). The precise frequencies are to be selected such that, at the display, the beat frequency in each case is a harmonic of the display horizonatal scan frequency. For example, assume a visual carrier with zero offset at 205.250000 MHz. For an 1125-line, 60-Hz display, f_H is 33.750 kHz. Therefore, harmonics of f_H are 33.750, 67.50, 135.00, ... kHz. Select the seventh harmonic of f_H (236.25 kHz) as the increment of frequency. Then, the test frequencies are:

205.25 - 5(0.23625) MHz = 204.06875 MHz
205.25 - 4(0.23625) MHz = 204.30500 MHz
205.25 - 3(0.23625) MHz = 204.54125 MHz
205.25 - 2(0.23625) MHz = 204.77750 MHz
205.25 - 1(0.23625) MHz = 205.01375 MHz
205.25 ± 0 MHz = 205.25000 MHz
205.25 + 1(0.23625) MHz = 205.48625 MHz
205.25 + 2(0.23625) MHz = 205.72250 MHz

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205.25 + 20(0.23625) MHz = 209.97500 MHz

At each of the 26 frequencies, increase the RF amplitude of the undesired signal to the threshold of visibility of the interference, as

determined by expert observers. Note the signal amplitude, as measured at the receiver input with the desired signal temporarily fully attenuated.

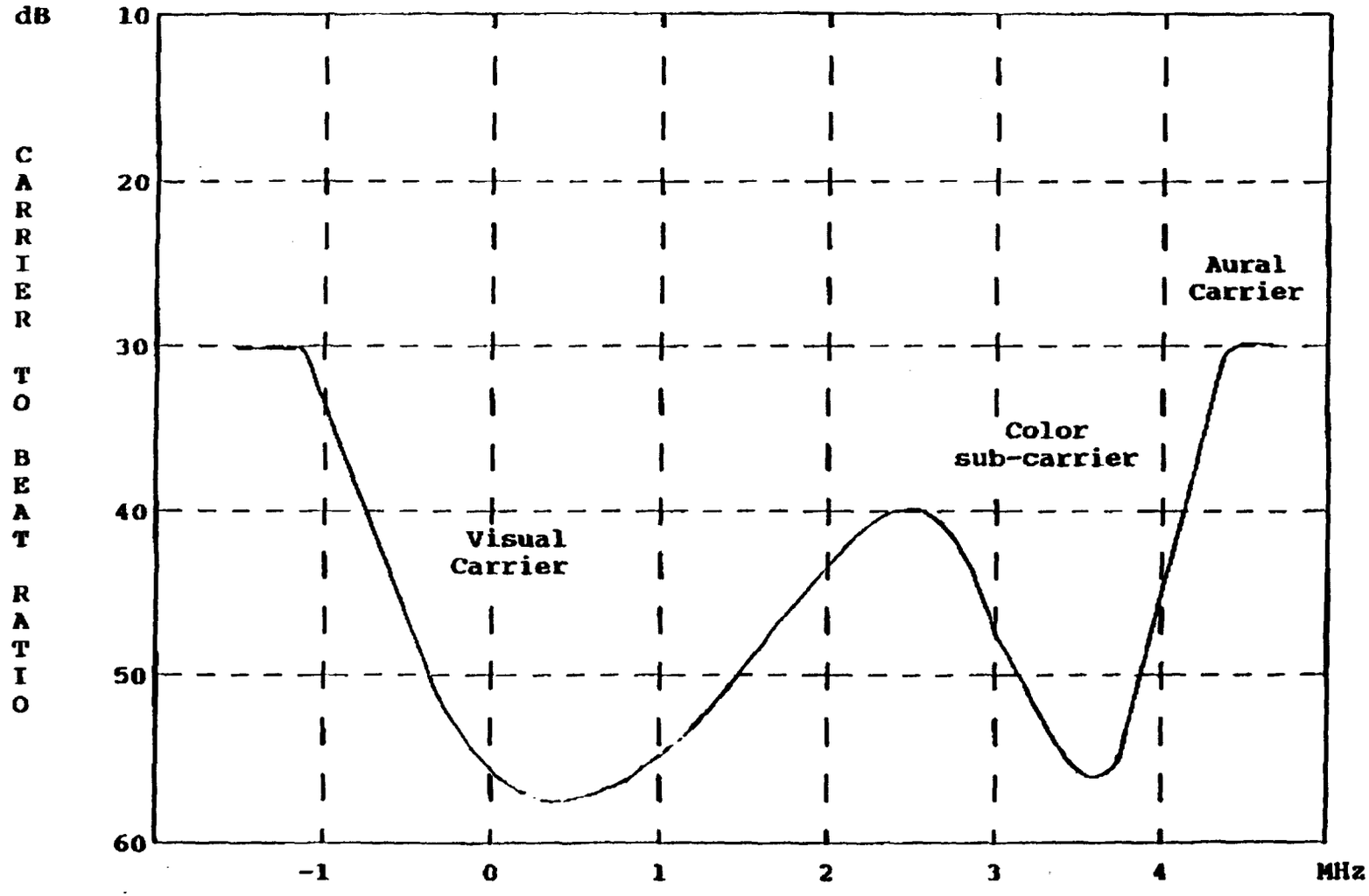
Make a rough plot of the 26 data points, as threshold level versus frequency, and try to draw a smooth curve to fit the data, similar to the "W-curve" for NTSC. Examine the curve to identify inflection points. At the direction of expert observers, take additional data at frequencies close to the inflection points in order to pinpoint the frequencies of maximum and minimum interference. The additional points shall be taken at frequencies that are appropriate multiples of f_H. Based upon analysis of the proponent system, SS/WP1 may have recommended potential maximum or minimum interference frequencies to be tested. At the discretion of ATTC, these recommended frequencies may be tested in addition to, or instead of, those identified by curve-fitting. Plot the BER at the visual interference threshold for each test frequency. Also determine the levels of interference at which the BER is reduced to 10^{-4} and 10^{-3}.

Some ATV systems employ time expansion in the receiver. In such cases, the display frequencies do not have a one-to-one relationship with the transmission frequencies. Select the test frequencies for these systems such that the beat frequencies, after time expansion, are harmonics of f_H, the display rate.

19.3.3.3 Presentation of Data

Document measurements of co-channel, adjacent-channel, and taboo-channel interference by completing the form shown in Figure --. Make DVTR recordings over the range from the threshold of visibility to system failure, and log the values of all variables for each recording.

Present the measurements of discrete-frequency interference in a graphical format, similar to the "W-curve" for NTSC. There should be three curves on a common set of axes -- visual threshold, 10^{-4} BER, and 10^{-3} BER. At points of peak interference, make DVTR recordings and log the test frequencies and amplitudes.



"W-CURVE for NTSC"

(Example of Presentation Format for Discrete Frequency Interference Date)

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19.4 Susceptibility to Group Delay Errors

Various hardware elements in a terrestrial transmission system can introduce signal distortions that produce artifacts in the demodulated video or audio. These distortions may be linear or nonlinear. Transmitters, transmitting antennas, translators, and MATV equipment are all potential sources of such distortion.

Experience with NTSC transmission has resulted in the establishment of tolerances on various forms of distortion such that the artifacts are held within acceptable limits. One industry standard that defines a number of distortions, describes measurement techniques, and sets tolerances, is ANSI/EIA-508-1987, "Electrical Performance Standards for Television Broadcast Transmitters."

It may be practical for an "NTSC-like" ATV transmission system to use transmitter and antenna hardware. In this case, performance may be inferred to be similar to that of NTSC and within the standards cited above. For other systems, this attribute is a transmitter/antenna implementation issue. In the absence of distortion definitions and measurement techniques for unknown, non-NTSC transmitting equipment, laboratory testing of this attribute by ATTC is not feasible.

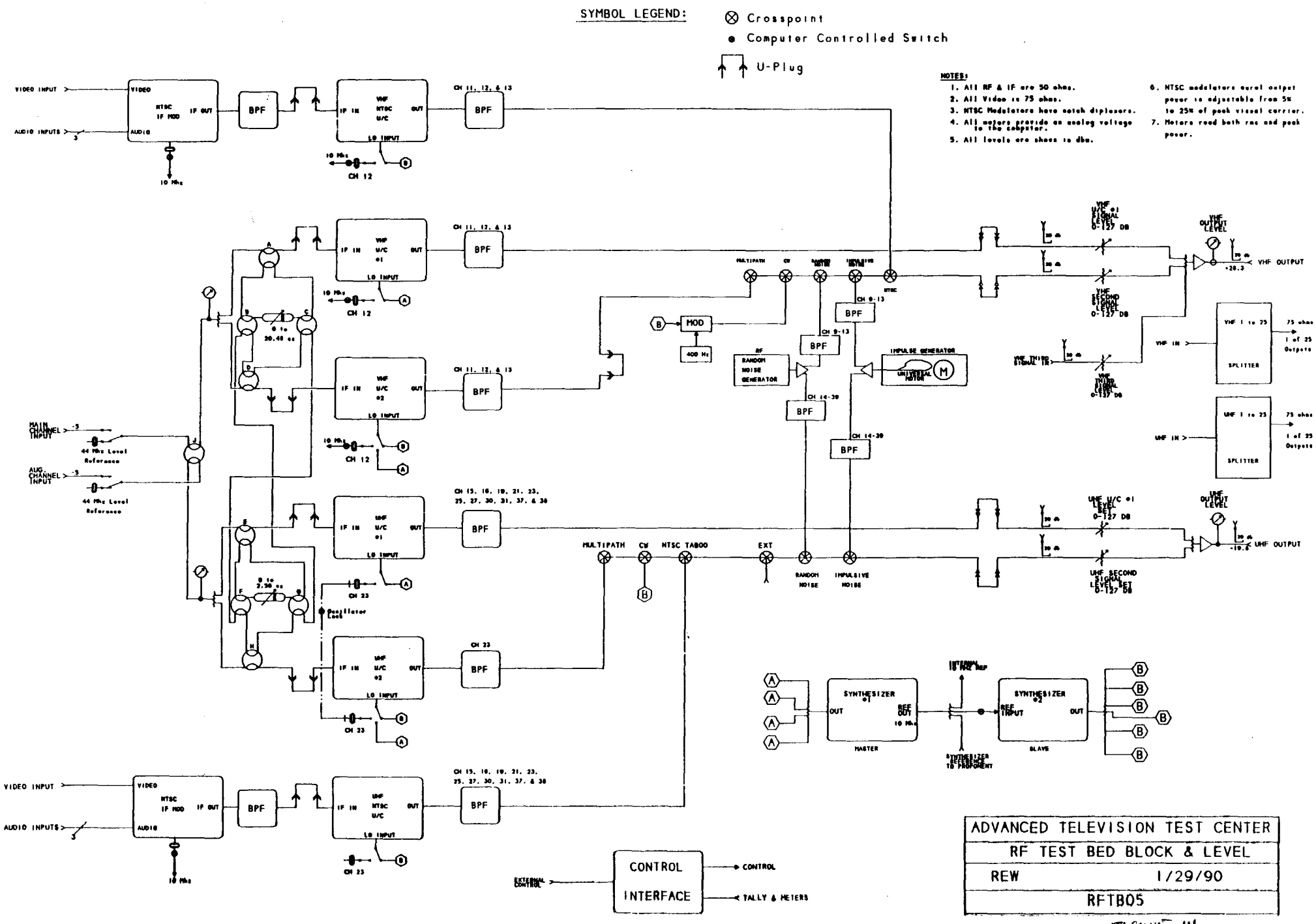
Based upon the foregoing considerations, the procedure released in the September 14, 1989, revision of this document has been withdrawn.

19.5 Susceptibility to Nonlinear Distortions

The procedure released in the September 14, 1989, revision of this document has been withdrawn due to considerations cited above in Section 19.4.

19.6 Gracefulness of Degradation

The procedures contained in this section, in the September 14, 1989 revision of this document, have been integrated into Section 19.1.1, Random Noise.



ADVANCED TELEVISION TEST CENTER	
RF TEST BED BLOCK & LEVEL	
REW	1/29/90
RFTB05	

FIGURE 14